

2018 ROOST MONITORING

By Heather Kaarakka

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Wisconsin Bat Program
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Bat “condo” sketch by Heather Kaarakka

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Table of Contents

It was another successful year for monitoring summer bat roosts in Wisconsin! Thousands of bats were counted at over 120 sites in 2018. With white-nose syndrome in the state, there were unfortunately a lot of downs, but a few ups this year too. Highlights include several persisting colonies and several volunteers observing silver-haired bats. Enjoy reading about everyone's hard work surveying their bats in 2018!



pg 1.
Background on bats

pg 2.
Wisconsin's bats

pg 3.
2018 roost monitoring effort

pg 4.
Results by roost type

pg 5.
Bat roosts by size

pg 6.
Bat roosts by type

pg 7.
Fourth annual Great Wisconsin Bat Count

pg 8.
Case of the curious roosts

pg 9.
Daily monitoring

pg 10.
Impacts of white-nose syndrome

pg 11.
Persisting colonies

pg 12.
How WPB uses information from volunteers

pg 13.
Continuing the bat roost monitoring project

pg 14.
References

pg 15.
Bat roost monitoring infographic



Little brown bats happily using the bat houses at the I-90 bridge site.

A background on bats

Bats are found on every continent except Antarctica, and have diverse diets including bats that eat fruit, insects, pollen, scorpions, fish and even blood.

Bats are cryptic and commonly misunderstood animals, but they are important to almost every ecosystem on the planet. Bats provide many ecosystem services including pollination, seed dispersal and **pest-insect control**. In fact, it has been estimated

that bats save farmers in North America upwards of \$22 billion in pest control services every year, and bats' services are worth \$1 billion each year to the corn industry alone^{1,2}.

Bats are important to Wisconsin's agricultural industry, but some species are under threat of extinction from a deadly fungal disease called [white-nose syndrome](#) (WNS). In 2006,

a fungus, later named *Pseudogymnoascus destructans*, was documented growing on the muzzles and wings of hibernating bats in a New York cave. The disease causes mass mortality in hibernating bats, and population die-offs of 90-100% are not uncommon. WNS and the fungus has spread to 36 states and seven Canadian provinces, and over 6 million bats have died from WNS since 2007. Unfortunately, WNS was confirmed in Wisconsin in March of 2014.

Sites in twenty-five counties are infected in the state as of fall 2018.

With the threat of WNS looming, the Wisconsin Bat Program (WBP) began efforts in 2010 to locate both summer and winter colonies of bats. Landowners and volunteers have helped WBP locate and monitor over 200 summer

... **bat roosts** in the state since 2010.

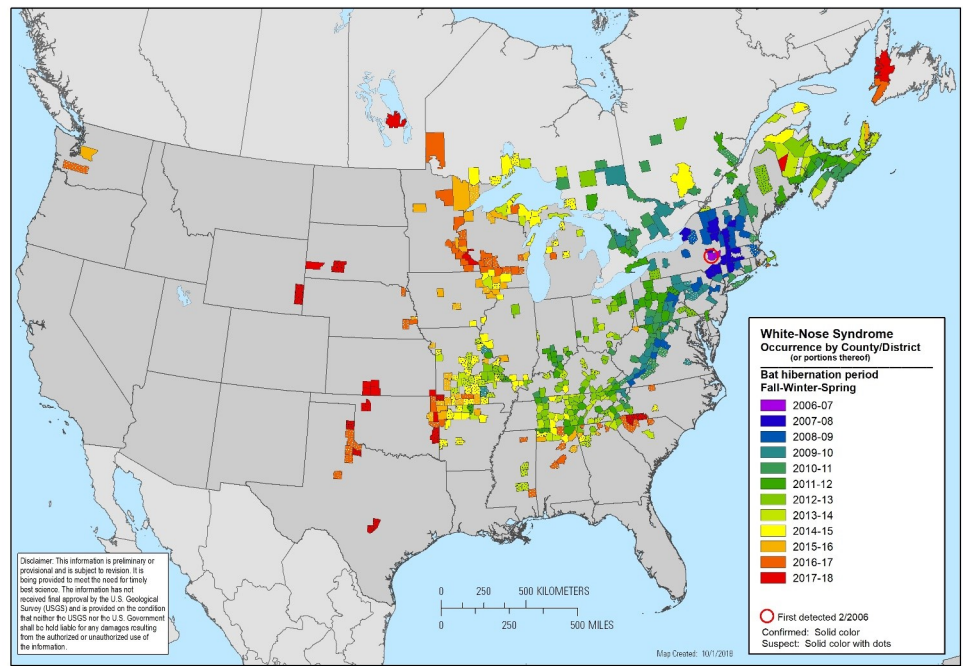
These monitoring efforts by citizen-

A single little brown bat can consume up to 1,000 mosquito-sized insects in one hour!

A roost refers to the area where bats congregate to rest during the day. Bats need these safe places to sleep and raise their young. Summer roosts can be trees, bat houses, attics, barns and other buildings, bridges and other secret places.

scientists helped WBP establish baseline information about where bats are, what type of roosts bats use, and how many bats inhabit each roost over the summer before declines from WNS are seen in the state. Now that the disease is here, these efforts continue to help WBP learn about impacts from WNS on the summer landscape.

Currently, Wisconsin has twenty-five counties where sites are infected with WNS or have the fungus causing the disease. Map: Lindsey Heffernan PA Game Commission



Wisconsin's bats

Wisconsin has eight species of bat, but only two are most likely to use bat houses or man-made structures- the little brown bat and the big brown bat. Little brown bats tend to use hot places in south-facing bat houses and barns, while big brown bats prefer cooler conditions. The warm temperatures help females bats gestate quickly and the newborn bats (called pups) mature quickly. These two species will also form large colonies in summer and bats often return to the same roost yearly. The other six species in the state are solitary or form much smaller colonies, use mostly trees in summer, and do not often return to the same roost sites making them much harder to find and monitor. As a result, WBP volunteers monitor primarily little brown bat and big brown bat roosts but in 2015, eastern pipistrelles were reported

Eastern pipistrelles are the state's smallest bat and are also called the tricolored bat.

roosting on a porch in St. Croix County. Since then, other colonies have been reported and several pipistrelle roosts are currently monitored.

Bats in Wisconsin return to summer roosts from winter habitat in April and May. By late May and June, most of the colony is present at the site. Bat pups are born in early June and are flightless for four to six weeks. In mid-July, bat roost monitors often observe an increase in bats because the juveniles begin flying. In August, the adults begin to leave their summer roost to go to winter habitat where they will forage and mate at the entrances of caves and mines. Females delay fertilization until they emerge or return in the spring.



An unruly silver-haired bat insists on roosting outside a bat house in Milwaukee County. Photo: K. & I. Haley

Roost monitoring in 2018

This year, 181 volunteers conducted over 500 emergence surveys in 51 counties from March to October. Volunteers monitored 130 roosts in summer of 2018 (down slightly from 145 sites in 2017) including 16 newly reported roost sites.

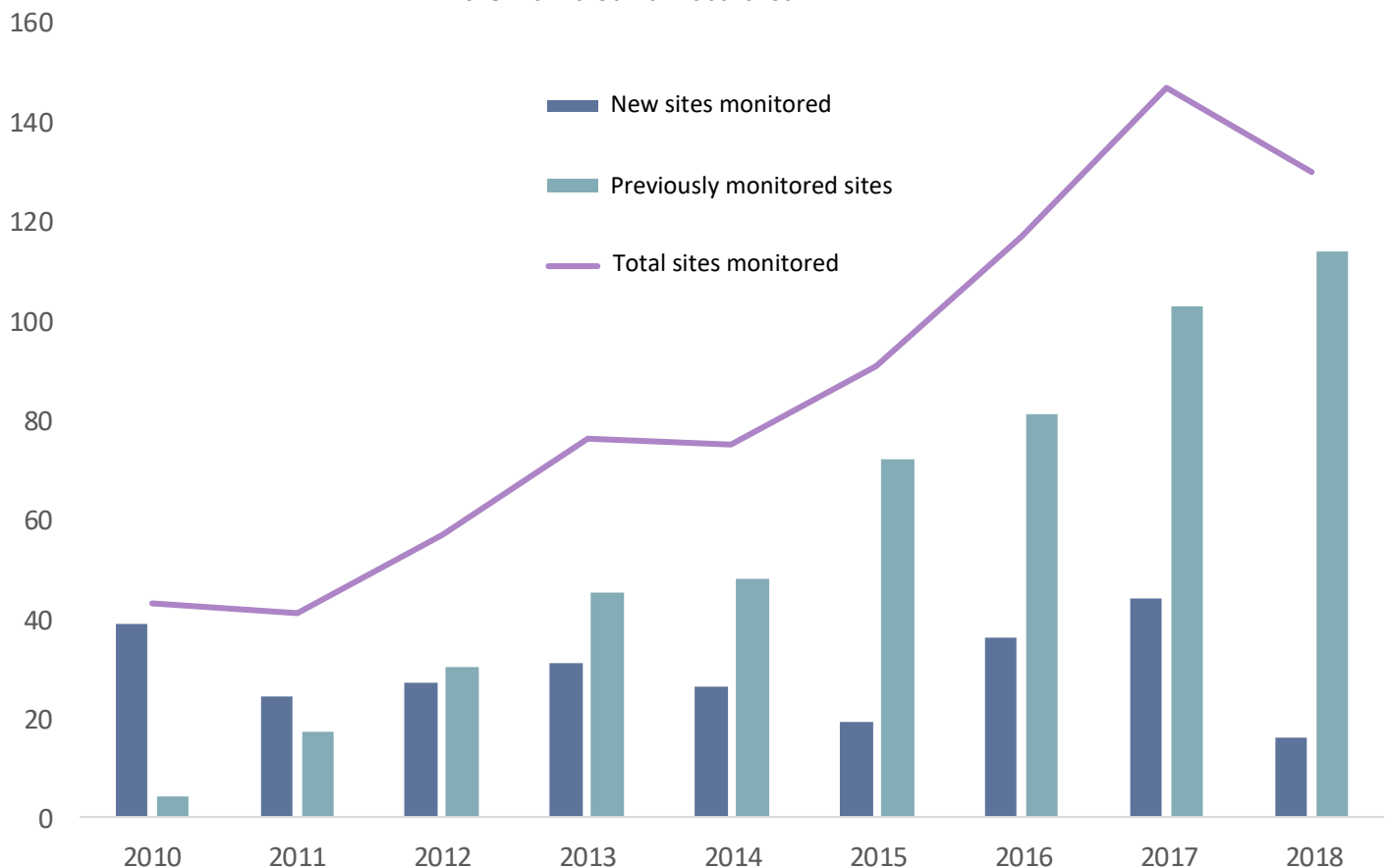
In 2018, the **total little brown bats** counted—**8,783**—was down by more than 50% from 2016 when 23,607 were counted. The **total number of big brown bats** counted—**3,419**—was up since 2016 and 2017. Total numbers counted are estimated from the highest counts at each site. Fourteen eastern pipistrelles were counted at three sites in 2018. Little brown bat roosts comprised 51.5% of monitored sites in 2018. Big brown bats were counted in 33.8% of the sites and the remaining sites house eastern pipistrelles, both little brown and big brown, or it is unknown which species is housed. See page 15 for more details in the roost monitoring infographic.



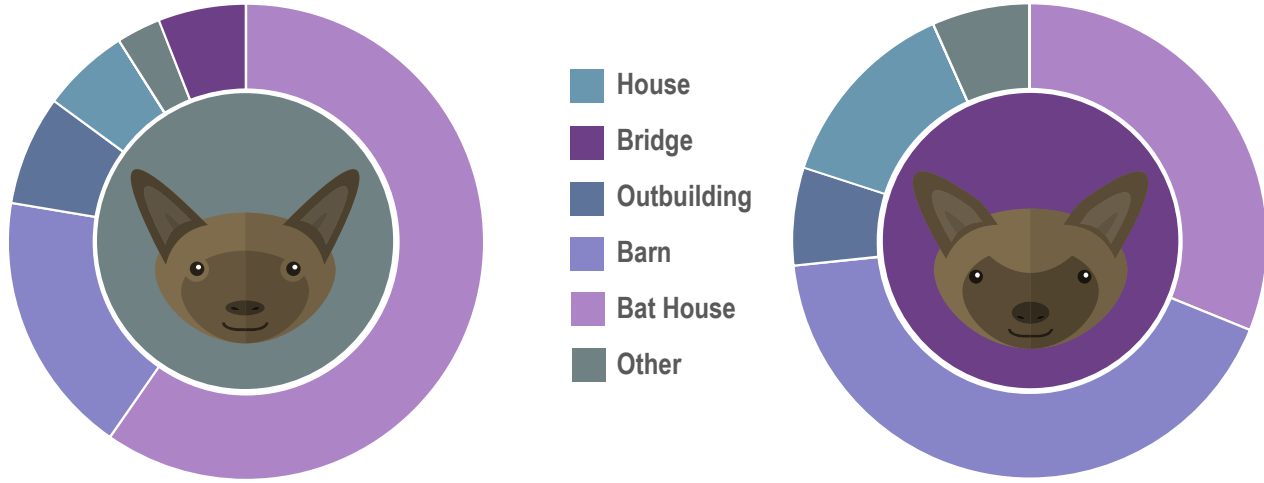
Above: Big brown bats hang out in a bat house which is hung up inside a barn.
Photo: DM Staccia.

Below: a graph depicting the number of sites monitored every year through the roost monitoring project.

2018 Monitored Bat Roost Sites



Bat species by roost type



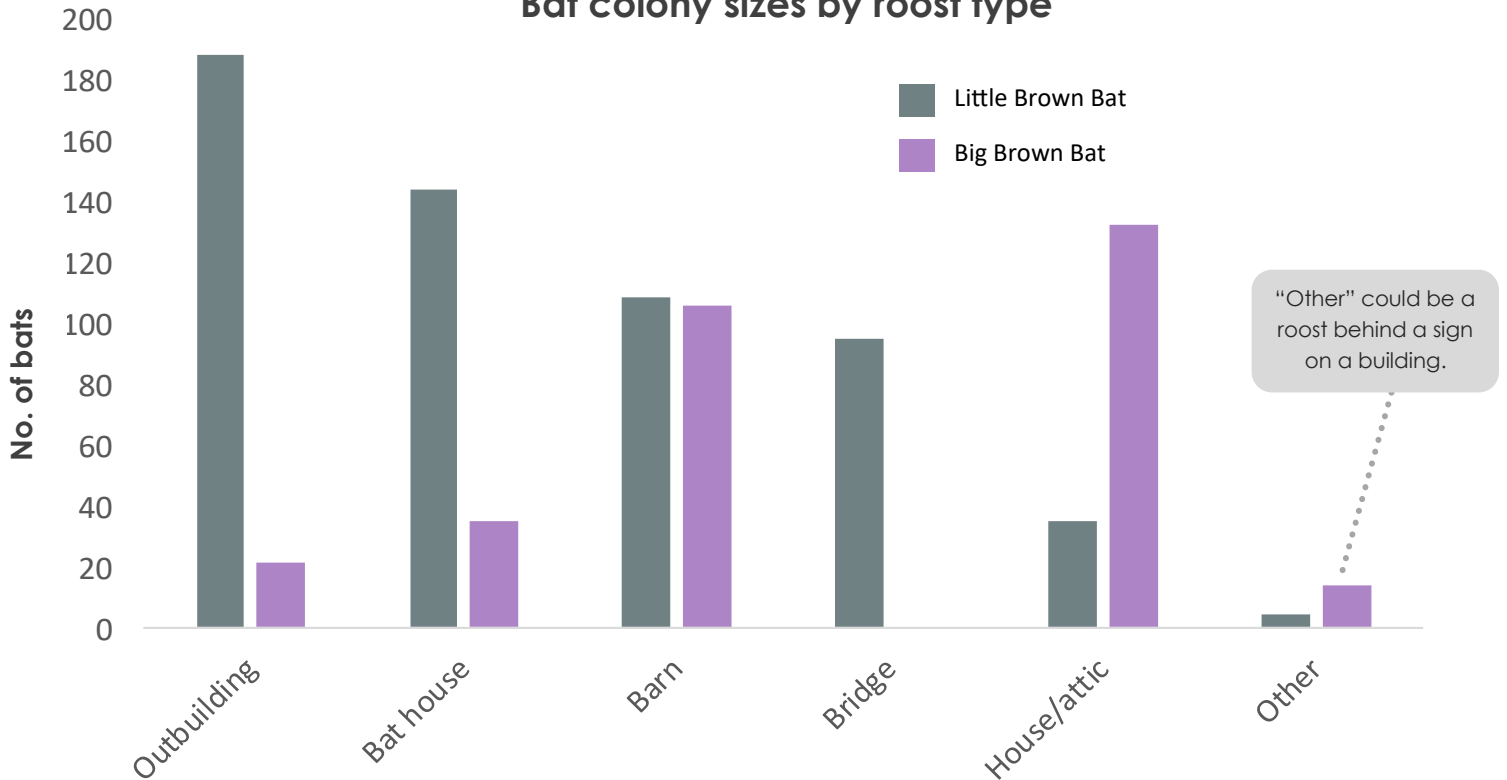
Little Brown
67 roosts

Big Brown
45 roosts

Above: sites of each species are split by type of roost. Little brown bats were found most often in bat houses, and big brown bats preferred barns.

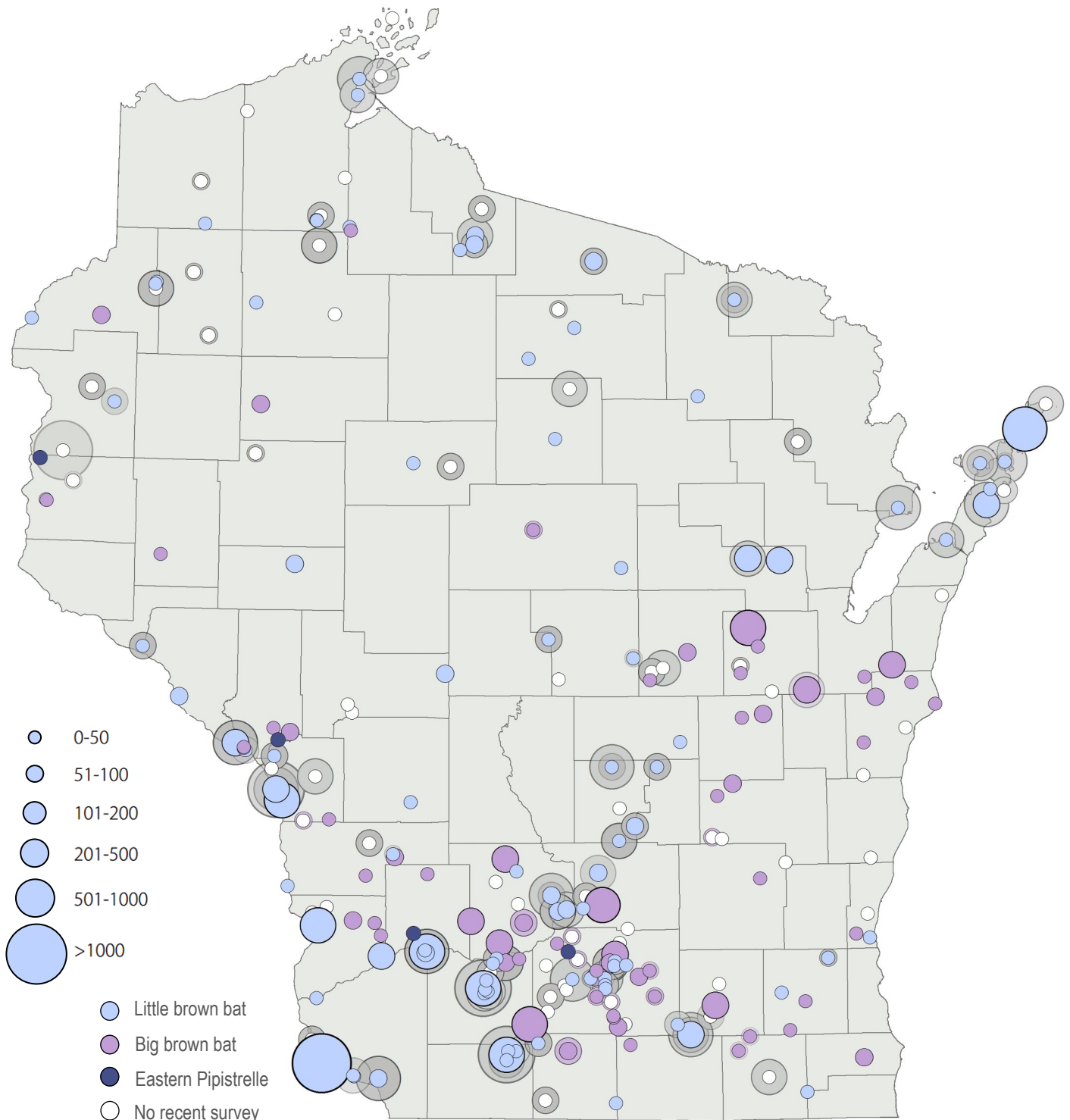
Below: Colony sizes for each species are sorted by the average of highest population size found in each roost type. Of note– results from 2016 had several average little brown bat roost colony sizes by type between 300 and 600 bats. Below for 2018, the highest little brown bat average colony size barely reached 190 bats.

Bat colony sizes by roost type



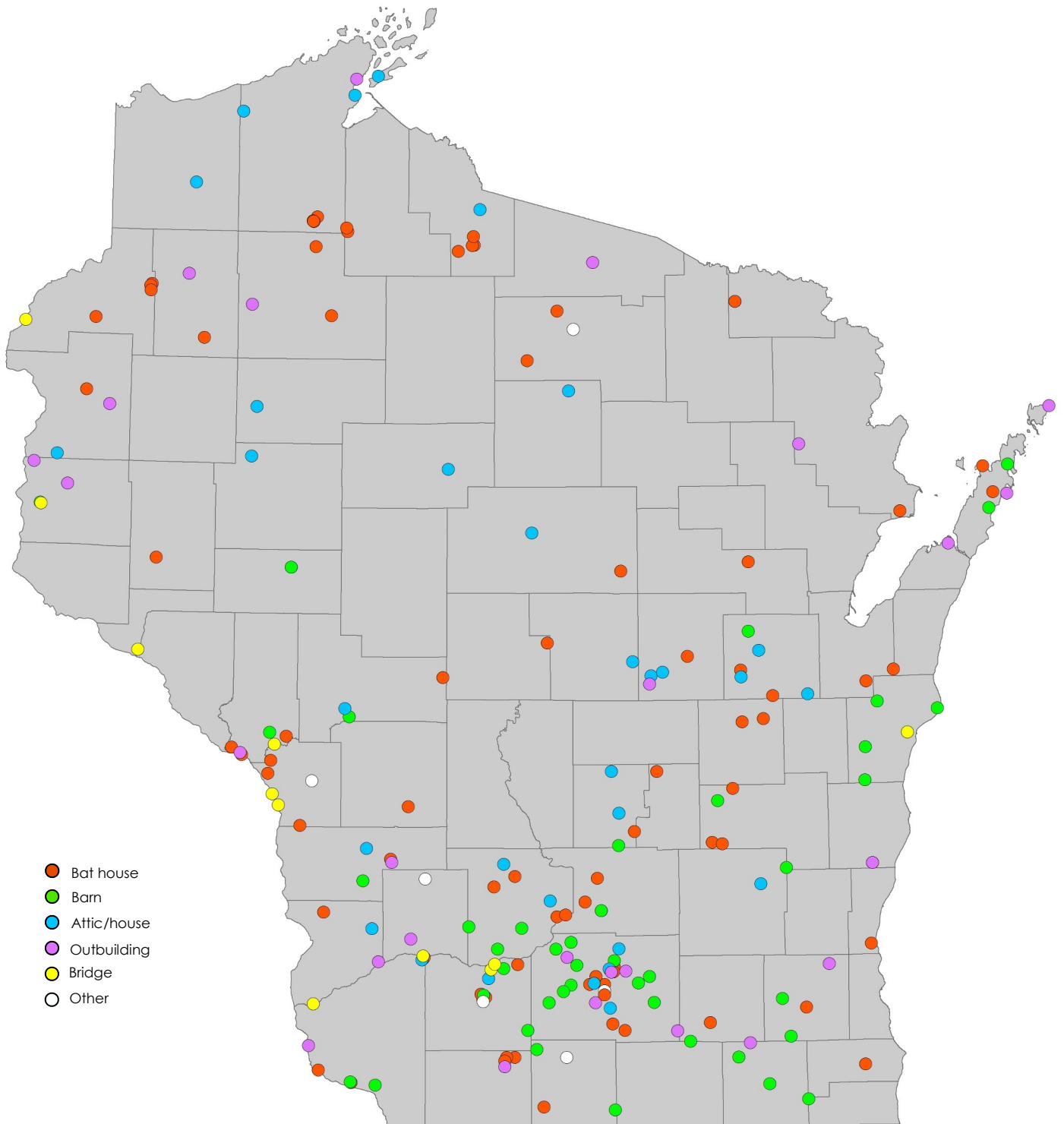
Bat roosts by size

The below map depicts the distribution of monitored bat colonies and their sizes in Wisconsin where purple indicates big brown bat colonies, light blue little brown bat colonies, and dark blue eastern pipistrelle colonies. Size of the dot indicates average size of the population at the roost. The shaded gray circles behind the roost locations are previous population estimates from emergence surveys.



Bat roosts by type

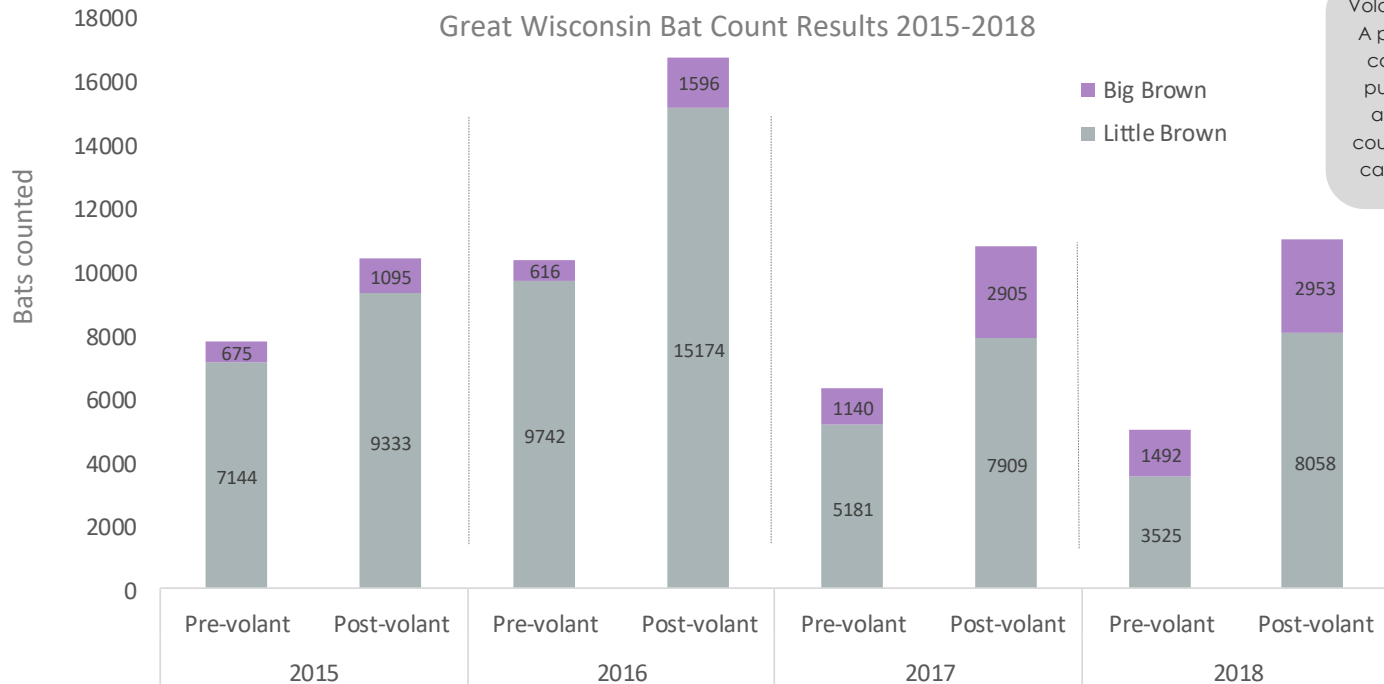
This map depicts the distribution of monitored bat colonies by type of roost. Color of the dot indicates whether the bats roost in a bat house, attic, outbuilding, barn, bridge or other.



Fourth annual Great Wisconsin Bat Count

WBP created a statewide bat count, similar to the Christmas Bird Count.

In 2015 we began the Great Wisconsin Bat Count, with the goal of counting as many roost sites as possible on a single weekend. Two statewide counts are completed yearly the first weekend in June during the pre-volancy period, and a weekend in mid- to late July during the post-volancy period to help investigate reproductive success of the monitored colonies. All statewide counts have been great successes. Including eastern pipistrelles, volunteers counted at 74 roosts in June, counting a total of 5,027 bats. In late July, volunteers surveyed 70 roosts and counted 11,011 total bats!



Volancy refers to flight. A pre-volant count is conducted before pups are able to fly and a post-volant count is after juveniles can fly on their own.



The Case of the Curious Roosts

Research on roosts sites for little brown bats and big brown bats generally agrees that there are a few factors that are important for bats in their selection of places to roost during the day. The most important factor appears to be heat—bats like it warm because it helps speed up everything so the pups have more time in late summer to learn to forage and gain fat. Other factors in roost selection may be safety—too much disturbance and predation risk may cause bats to decline roost sites; and proximity to foraging areas—many bats like to forage over water, and any way to reduce commuting costs by roosting closer to feeding areas may be better for bats. We observe lots of successful little brown bat roosts within 1/4 mile of open water.

Beyond these factors, we don't know much about why bats choose specific spots to hang during the day, and sometimes they find strange places to roost. While not terribly bizarre, roosts behind shutters are still outside of what we normally think of as a "bat house" and some bat house builders have tried mimicking the form of shutters when they design boxes. More com-

monly found further west, but still observed here in Wisconsin, Spanish shingles seem to make pretty good bat roosts! Especially on south-facing roofs, little brown bats will pack into the gaps under the shingles.

Bats roosting under patio umbrellas can be something of a surprise when landowners open them, but the closed umbrella mimics the tight spaces found in dense leaf clusters and under sloughing bark on trees.

Have you ever thought about putting a window into your bat house so you can watch your residents as they go about their business? Well, a roost in Crawford County is a built-in bat observatory! Netting placed on the windows to prevent bird strikes, combined with a shade on the outside makes a great roost for big brown bats. The landowner can watch the bats from inside her house and has had upwards of 50 big brown bats at a time.

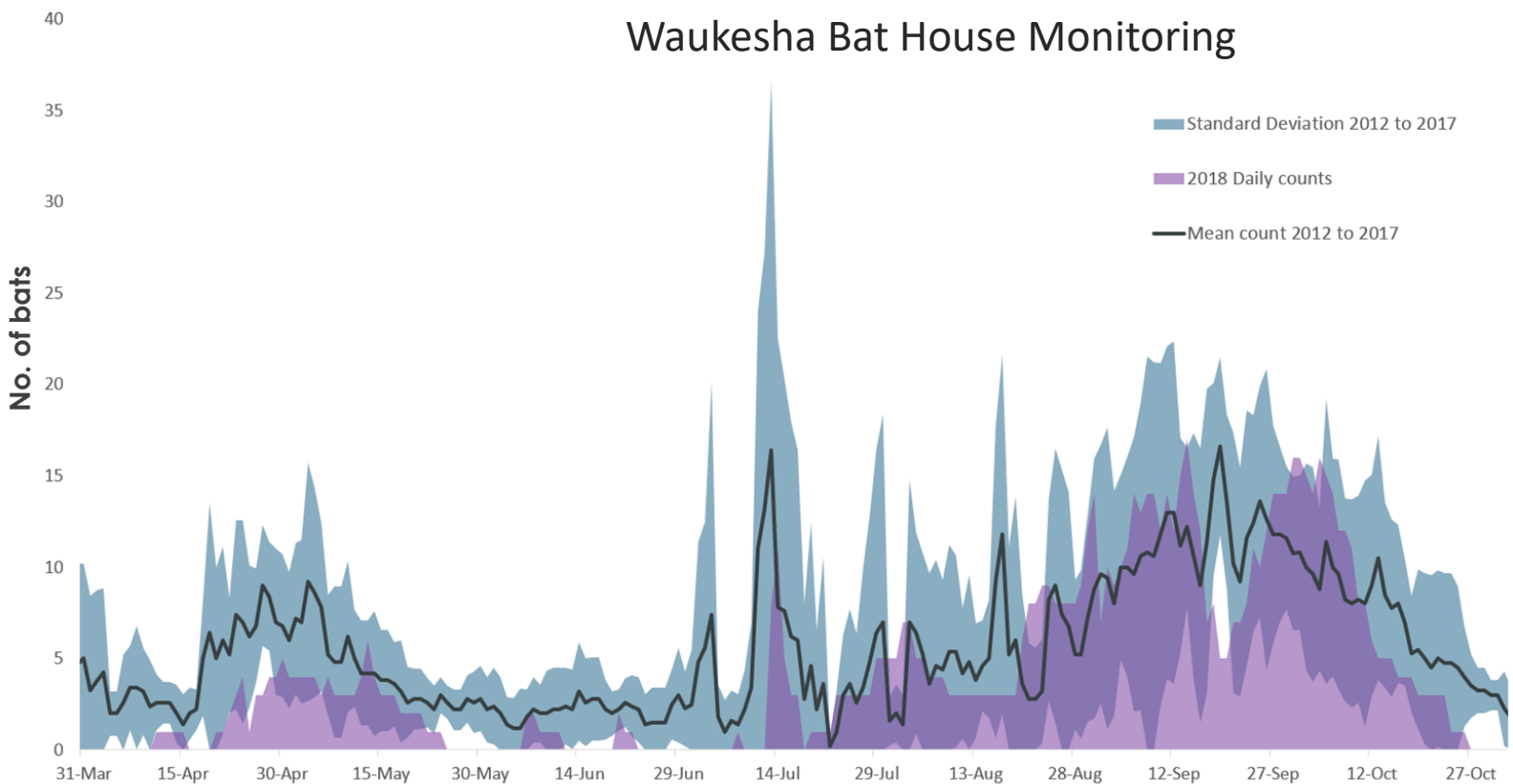
You never know where you might find a bat roosting, and these cryptic animals are pretty good at finding tight and sometimes strange spots to hang.



Above left: A Myotis species roosts in a patio umbrella – photo: DM. Staccia. Above Right: Big brown bats roost in a window in Crawford County allowing the landowner to observe the bats during the day – photo: M. Jones.

Daily monitoring

Waukesha Bat House Monitoring



The above graph depicts daily counts from the summers 2012-2014 and 2016-2018 at a single-chamber bat house housing big brown bats in Waukesha County. While big brown bats are known to periodically switch roosts over the course of the summer due to various factors such as ambient temperature, and parasite load⁴, the daily monitoring of this roost in Waukesha County shows just how often big brown bats move among roost sites. The landowner and surveyor, Jim, has spent over 100 hours over the last six years monitoring his bats! When the number of bats displayed is zero, it means that zero bats were counted in the roost, not that no count was completed. Because of the difference in numbers of bats, even daily, inhabiting this roost, it is unlikely that this is a maternity roost since there are few bats present in June, and pups are difficult to move and carry after they reach a certain weight. There are likely several roosts in the area that these bats move between over the course of the summer.

With six years of monitoring, the graph begins to look muddy. In an effort to make the Jim's data easier to interpret, the counts from 2012 to 2017 are averaged and depicted as a black line above. The blue area around the average displays the standard deviation, or how the counts for that day vary around the mean. The purple area depicts counts for 2018. The bats in this roost show

up in late March or early April, and varies likely because of conditions (a cold spring can delay activity which likely happened this year). The majority of the bats then leave the roost in late May. Though the timing of jumps in numbers doesn't exactly match every year, there are clear patterns of larger numbers of bats arriving in the second half of April and leaving in early May. Likewise, all years show a jump in population starting in late August, and most bats leaving in October indicating this roost may be used as a migratory stopover for bats moving from winter to summer habitat and vice-versa. From the standard deviation, one can see that there is much more variation in numbers in the second half of the summer than the first half. Curiously, there seems to be at least one brief, large jump in bat numbers in mid- to late July. The timing of this jump in mid-July lines up roughly with when we start to see juvenile big brown bats begin to fly. A hypothesis for the observed increase might be that juveniles are exploring and finding new roost sites during this time period. Big brown bats may also respond more to changes in temperature, with warmer temperatures driving them to find cooler conditions. It is possible hot days in July and August cause the bats to move to alternate roosts which could result in the sudden jumps and declines in colony.

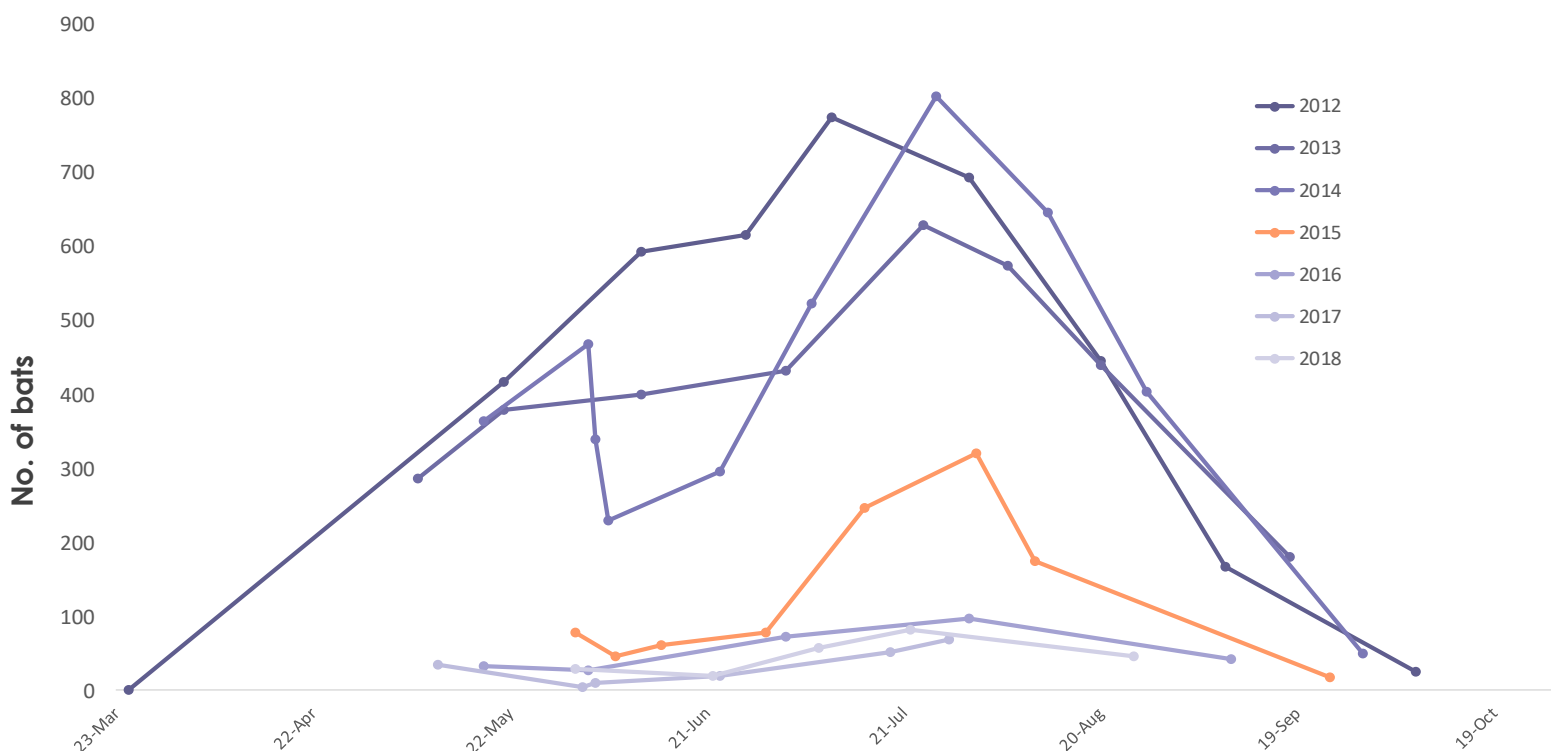
Impacts of white-nose syndrome

This graph below depicts counts conducted at a barn roost several times over the summer every year since 2012. This barn in Door County housed a significant population of little brown bats until the past three summers. Thanks to the efforts of volunteers, a baseline population was established prior to the arrival of WNS. For three years the population has been steady between 600 and 800 bats. In 2015 however, a significant decline was documented. In 2015, less than 20% of the normal population was counted until late July when the colony jumped in size to less than half of previous years' numbers. In 2016, the colony struggled to reach 13% of the average colony size in late July. This trend of ~50% decline one year and nearly 90% decline during the next year aligns with observations from biologists in the east⁵. This year the colony is at 10% of the highest counts, and ~14% of averaged high counts 2012-2015 which is up slightly from last year.

In the winter of 2013-2014, white-nose syndrome was confirmed in four counties in Upper Peninsula Michigan (UP), well within migration distances of

little brown bats using summer habitat in Door County⁶. Typically, when WNS is first observed in a hibernaculum, few dead bats are found and significant population declines are not observed during the first winter of infection. Mortality and population declines are usually observed in the second and third years of infection. Because of the barn's proximity to infected hibernacula in the UP and Door County (infected in spring 2015), and the dramatic declines in population after WNS has been present for three years, we surmise that this is evidence of WNS impacts on the summer landscape.

Unfortunately, impacts from white-nose syndrome have been observed statewide for the past few years. Most landowners with little brown bat roosts reported few or no bats return to their summer colonies this year. Yellowstone Lake State Park with its 30+ bat houses would routinely house over 3,000 little brown bats in summer. The highest count this year was 604, a decline of about 82%. Interestingly, several sites on the western edge of the state continue to



Population trends from a little brown bat colony in Door County, Wisconsin, displaying declines from white-nose syndrome. Year that first impacts from WNS observed highlighted in orange.

Impacts of white-nose syndrome

house colonies within past, normal size ranges, indicating that the spread of WNS may be moving east to west across the state, and possibly that bats are concentrating in areas with favorable foraging and roost habitat. Many colonies monitored yearly had numbers varying from 3% to 60% of average sizes pre-WNS. With much smaller colony sizes in early summer, we also observed congregations of bats in smaller roosts (smaller bat houses for example) especially early in the summer, possibly because there weren't the numbers of bats needed to fill bat houses and maintain warm temperatures through clustering. As it became warmer throughout the summer, we observed bats moving among larger roosts.

With the exception of a few roosts in southern Wisconsin, all reported declines have been at little brown bat and eastern pipistrelle roosts. Unfortunately, eastern pipistrelles are no longer showing up at most monitored sites. Big brown bats do not appear to experience the same declines from white-nose syndrome as little brown bats and eastern pipistrelles. There are still many questions to be answered about big brown bat roosting ecology before we can describe why drops in summer populations may be observed in this species.



A northern long-eared bat infected with white-nose syndrome in Crawford County.

Persisting Colonies

Thanks to the monitoring efforts of landowners and volunteers, the WBP has been able to identify several key roost sites around the state where little brown bat colonies appear to be persisting in large numbers despite impacts from WNS. Two roost sites along the Mississippi River in Grant County this year had post-volancy counts of over 50% of historical numbers. These sites used to be home to more than 1,500 and 3,000 bats meaning both roosts continue to house significant colonies in the age of WNS. Another recently identified roost in Door County along Lake Michigan housed over 800 little brown bats this summer, however we don't have historic counts for this site and we can't say how much of the original colony is surviving. Regardless, 800 little brown bats is a large colony even by pre-WNS standards. We will watch these sites closely in the coming years with the hope that these bats are survivors.



*Banding is one method used to monitor individual bats over long periods of time, and provides the opportunity to recapture bats at locations other than where they were banded. **Above left:** A little brown bat at a persisting maternity colony waiting for a band. **Above right:** A little brown bat receives a lipped band on its forearm.*

How Wisconsin Bat Program uses information from volunteers

Reported and monitored bat roosts are important for furthering research and understanding of bats and white-nose syndrome in Wisconsin. Thanks to the efforts of volunteers and landowners, Wisconsin is unique and fortunate to have an established database of summer roost sites throughout the state which acts as a springboard for other important projects investigating bats and WNS in the state. This summer we were able to help coordinate and complete several projects at reported summer roost sites.

- **University of Wisconsin-Madison project investigating bat diet and the importance of bats as pest control in the state.** Amy Wray, PhD student of Dr. Claudio Gratton and Dr. Zach Peery, is coordinating a project collecting guano and insect samples at summer roosts around southern Wisconsin. The guano will be analyzed genetically and the project will get a detailed look at diet of bats roosting in agricultural landscapes. The project began in 2014 and this summer was the last field season, but with five years of data, Amy can track colonies and their diet as WNS invaded the state. Some of the participating landowners collect guano for Amy, while other sites get full surveys of bat activity, guano, and insect collections. From collected and analyzing guano, Amy has found that both little brown bats and big brown bats consume mosquitoes!⁷
- **Banding bats at summer roost sites to recover marked individuals in hibernacula.** Little to nothing is known about the movements of bats between summer and winter habitat in Wisconsin. Because



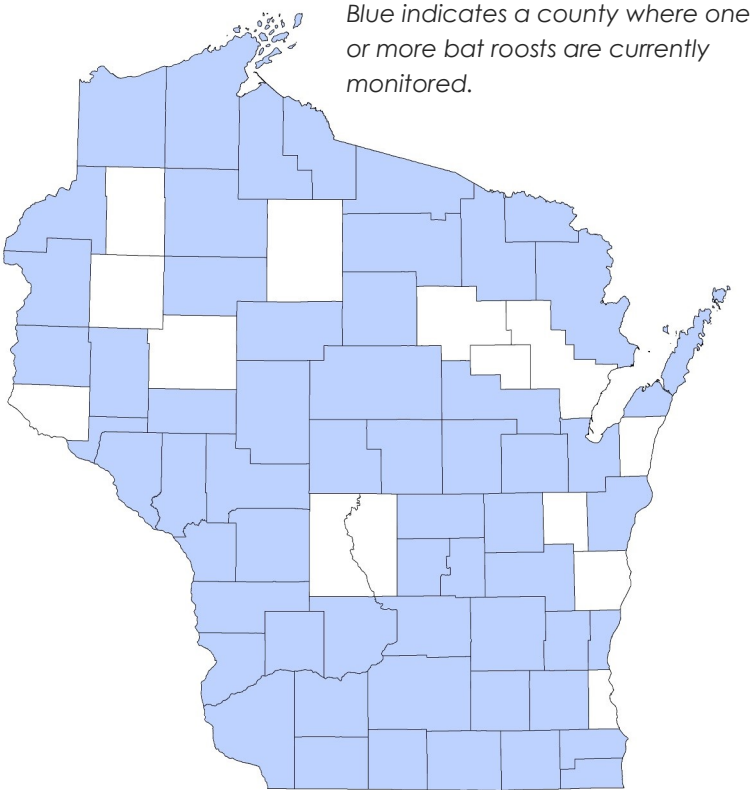
After guano is collected at bat roosts in southern Wisconsin, Amy extracts the DNA, and eventually sends it through a polymerase chain reaction (PCR) analysis to determine what the bats are eating.

bats congregate in a small number of sites in winter, chances of recovery of bats that were marked on the summer landscape is thought to be high. To begin investigating bat movements, WBP selected 14 significant little brown bat colonies in the southwest portion of the state at which to trap and band. WBP banded over 1,300 little brown bats at these sites in 2015 and 2016. While trapping at the same sites in 2016, we recaptured 24 individuals (2.8% recovery rate), and we noted how well bats seemed to remember what occurred the previous year. To funnel bats into the trap, we set up tarps around the roost entrance so they must fly into the trap; however, bats at almost every site had ingenious ways of escaping beneath the tarps or avoiding the trap. After a year off (to hopefully help forget what happens during trapping), this summer WBP banded about 500 bats at seven roost sites including those of the banding effort in 2015 and 2016. Three individuals banded in 2015 and eight from 2016 were recaptured at roost sites where they were banded.

Continuing the Bat Roost Monitoring Project

Over the past eight years, volunteers and citizen-scientists have helped create an important database of bats roosts around the state. Each roost reported and emergence count completed helps create a better picture of summer bat roosting ecology in Wisconsin. The amazing efforts by landowners and volunteers are extremely valuable and we will continue monitoring current (and future!) roosts in the coming summers. WBP also continues aims to grow the summer bat roost database. Every year the number of monitored roosts grows and gives the WBP important information. The map at right shows each county where bat roosts are monitored in Wisconsin. If you know of a bat roost in a county lacking a monitored roost, or even in a county where bats are currently monitored, please feel free to report it!

Feedback from the Great Wisconsin Bat Counts continues to be positive, and WBP will continue this



new tradition in the coming years. Even if volunteers are not able to participate in the Great Wisconsin Bat Counts, you are still encouraged to conduct emergence surveys each year. Each survey conducted adds to the growing database of baseline information about bat roost population trends across the state, and now as WNS invades. This critical information gathered by volunteers helps WBP investigate the full impacts of white-nose syndrome on bats in Wisconsin and helps inform recovery of bats post-WNS.

The bat roost monitored project is able to thrive because of the incredible work of volunteers and landowners. **We cannot thank everyone involved enough for their dedication and effort.**

I am constantly amazed by and thankful for the effort put forth by everyone who volunteers for the bat program, whether it be counting a roost or conducting an acoustic survey. It is truly magical to witness the excitement people have about bats and science, and I count myself very lucky to be a part of it. There is a long, hard road ahead with WNS finally in the state, but thanks to your efforts, we have made great strides in preparing for the disease. It may seem excessive, but thank you. We cannot continue the program without your help and support.

Heather Kaarakka
Bat Roost Project Coordinator



Heather Kaarakka removes a bat from a mist-net in northern Wisconsin.
Photo: Michael Kienitz

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Have questions about bats or roost monitoring?

Feel free to contact Heather:

heather.kaarakka@wisconsin.gov

608.266.2576

The Wisconsin Bat Program is part of the Bureau of Natural Heritage Conservation in Wisconsin Department of Natural Resources. The majority of Bat Program funding comes from grants and donations and much of our data is collected by volunteers. Thank you for your support.

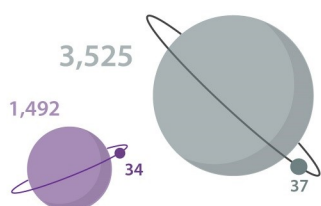
572 surveys
were completed in 2018, counting
13,174 bats

Great Wisconsin Bat Count

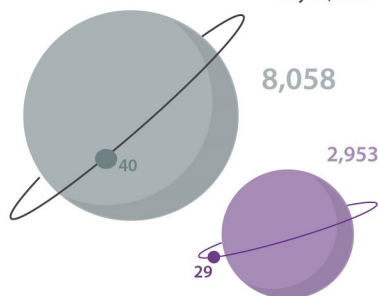
The goal was to count as many roosts as possible in a single weekend.

- Little brown bats counted
- Little brown bat surveys
- Big brown bats counted
- Big brown bat surveys

June 1, 2018



July 20, 2018



A bat colony's summer

05

May: the roost colony population steadily grows as bats return to their summer roost from overwintering habitat.

06

June: most of the colony is present at the roost, and female bats give birth to flightless young.

07

July: bat pups born in June begin to fly in late July and the number of bats emerging from the roost increases.

08

August: adults begin migration back to winter habitat where they will mate throughout the fall.

Number of roosts counted in 2018

Big Brown Bat



45

67



Little Brown Bat

Wisconsin Bat Program | Wisconsin Department of Natural Resources

Roost Monitoring Report



2018

Outbuilding attics attract large crowds

In 2018, outbuildings and bat houses housed the largest numbers of little brown bats.



Meet a couple of our bat species

Two bats that use artificial roosts in Wisconsin are the little brown bat and the eastern pipistrelle



Eastern Pipistrelle

Perimyotis subflavus

This little bat likes to eat caddisflies and beetles, and roosts in leaf clusters or open areas of buildings. In winter, pipistrelles hibernate in caves and mines.



Little Brown Bat

Myotis lucifugus

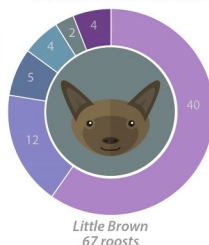
This common bat species eats small aquatic insects and roosts in bat houses and buildings in the summer. In winter, they hibernate in caves and mines.

Where do bats live?

The bats we count live in a variety of man-made structures.



181 volunteers reached for their clicker-counters this summer to help count bats



Little Brown 67 roosts

- Barn
- Bat house
- Outbuilding
- House
- Other
- Bridge



Big Brown 45 roosts

Help survey bats!

Know a place where bats roost? Want to help count bats?

Contact Heather at heather.kaarakka@wisconsin.gov or visit wiatri.net/inventory/bats

Produced by the Wisconsin Department of Natural Resources and the Bureau of Natural Heritage Conservation | 101 S Webster St, Madison, WI 53707 | DNRBureauofNaturalHeritageConservation@wisconsin.gov